



4-1-1999

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Greg Shailer

Australian National University

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Recommended Citation

Shailer, Greg (1999) "Classificatory Loan Pricing as an Incentive for Signalling by Closely Held Firms," *New England Journal of Entrepreneurship*: Vol. 2 : No. 1 , Article 6.

Available at: <https://digitalcommons.sacredheart.edu/neje/vol2/iss1/6>

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Classificatory Loan Pricing as an Incentive for Signaling by Closely Held Firms

Gregory E. P. Shailer

The signals owner-managers provide to prospective lenders by either directly providing information or taking observable actions may assist a lender in allocating default probabilities based on the lender's prior knowledge of group characteristics. A stylized "lemons" loan pricing model is developed to measure the value of such signals. The model may be useful to researchers in studying the access to and costs of financing for small firms and entrepreneurs, potential differences in behavior or decision bases across lenders, and cost-benefit analyses of signaling devices.

This article models how identifiable risk premiums in the pricing of loans to small firms by institutional lenders provide an incentive for individual owner-managers to signal the quality of their firms. While the existence of such incentives may be generally recognized, the model also provides a basis for quantifying the value to borrowers of such signals. The loan pricing model is derived from Akerlof's description of "lemons" pricing.¹ This approach allows interest rate premia attaching to signals to be depicted as a simple additive function representing a classificatory approach to loan pricing which is consistent with observed schema of interest rates and the banking literature. Although the adopted approach has not previously been elaborated, support for the simplified model is drawn from the established literature regarding information asymmetry, loan screening, and pricing.

Owner-managed (unlisted) firms are suited to such a simplified modeling approach because they are not directly affected by external residual equity pricing (signaling) issues, although the loan pricing problem is not necessarily limited to such firms. The consequential absence of equity market effects on information capture and capital instrument pricing for unlisted firms implies debt providers must rely on the direct acquisition of information of the default risk (quality) owner-managed firms. The adopted modeling approach also limits empirical applications to cases of generally uniform or standardized products (loan agreements) usually associated with lending to small (owner-managed) firms.

The ability of lenders to directly obtain information on the quality of borrowers is critical where borrowers have information on their quality that lenders do not. It is often suggested that such information asymmetry is a major prob-

lem for lenders.² It has also been observed that this problem is acute for small and closely held firms.³ It is desirable, therefore, to consider how lenders respond to such circumstances and the implications this has for measuring the potential returns to borrowers of reducing such information asymmetry by signaling their quality to lenders.

Although institutional lenders can contract for the provision of particular information, monitoring of quality and contract enforcement is costly. The lender's search costs and any remaining information risk is factored into the debt pricing (this is a simplified version of the proposals in Stiglitz and Weiss⁴). Borrowers may be able to avoid these costs by voluntarily providing information to the lender. Akerlof argues that where market imperfections are sufficient to prevent buyers from adequately distinguishing product quality, higher quality products are undervalued. Akerlof's 'lemons' pricing argument suggests that lenders will price loans to compensate them for mistakenly funding defaulters.⁵ This suggestion is developed here to construct a pricing model, based on the availability of information regarding loan applications from owner-managed firms.

Jaffee and Modigliani⁶ suggest that banks employ classificatory pricing in the context of discriminatory rationing. They also suggest that banks classify borrowers into different classes to be charged different rates, although this is without reference to information asymmetry or signaling:

... an effort would no doubt be made to choose the criteria for classification so as to minimize the difference between the optimal classification of customers into rate classes and the categories dictated by the objective criteria.⁷

Following Akerlof's approach, where a lender cannot adequately distinguish the relative qualities (default risks) of borrowers, the borrowers are pooled and all are charged equal effective interest rates that generally approach those applicable to the lower quality firms. Owner-managers that perceive their firms as higher quality borrowers thus have an incentive to signal their quality difference to the lender. Those that signal successfully are charged lower interest rates than other owner-managed firms. This leads to a simple but potentially informative view of loan pricing that allocates borrowers to risk categories on the basis of nominated information cues.

The Basic Loan Pricing Model

Essentially, borrowers are either "good borrowers" or "defaulters." A good borrower, by definition, does not default. A defaulter fails to pay all or part of the principal and accrued interest obligations when due. The lender will not lend to a predicted defaulter. Where the lender cannot distinguish good borrowers and defaulters, all loans are priced at the weighted average interest rate r_p which reflects the lender's expectation of the average default risk of the loan pool. A loan pool is defined as a set of loans which the lender can not separate on the basis of quality. This implies that the lender assigns the same prior probability of default to all of the loan dollars in the pool. These pools are the basis for categorical pricing. The expected returns from good borrowers have to satisfy the lender's required return on total loans:

$$(1-q)(1+r_p)D=(1+r_o) D \quad (1)$$

Where:

q = The lender's predicted proportion of defaulted accrued debt, being the probability of default attributed to each dollar in the pool.

= where d_i is the amount outstanding for loan i , with k loans in the pool.

$D=\sum_{i=1}^k d_i$ r_o = The lender's required rate of return on the loan pool.

r_p = The weighted average interest rate applied to all borrowers in the loan pool.

The left-side term in (1) is the total principal and interest that the lender expects to recover from the pool. This is equated to the total dollar collections *required* by the lender from the total loan pool (the right-side term) by manipulating r_p . The levied interest rate r_p is obtained from (1) as:

$$r_p = \frac{r_o + q}{1-q} \quad (2)$$

As q increases, so does the loan price for the pool. The difference between the lender's required rate of return r_o and the levied interest rate r_p is the default premium, labeled p , which also includes expected monitoring and collection costs. Subtracting r_o from (2) yields:

$$p = \lambda (1 + r_o) \quad (3)$$

Where:

The default weighting $\lambda = \frac{q}{1-q}$ is the expected ratio of dollars defaulted to dollars repaid. $1-q$

At the limit, if the lender predicts that there are no defaulters in the loan pool ($q=0$), then the default premium is 0. As the proportion of defaulters approaches 1, the premium approaches infinity.

The default premium as an incentive for signals⁸ is considered below using a "two-pool" case. This is then generalized to include multiple information cues which allows for more idiosyncratic pricing after which possible signals are canvassed.

The Value of Signals

The default premium levied against the loan pool is avoided if the borrower credibly signals its quality and is thus differentiated from the rest of the loan pool. The effect this has on the loan rate levied to that borrower can be used to measure the value to the borrower of providing the signal. If a good borrower unambiguously signals⁹ its quality, it is removed from the pool and charged r_o . The number of good borrowers in the original pool is reduced so that the proportion of defaulters increases,¹⁰ increasing r_p for the remaining firms.¹¹

Generalizing from the simplistic "default—no default" approach, firms that effectively signal their relative quality will be assigned to different pools with different expectations of default. This is illustrated with a two-pool example where it is assumed that a lender's relevant loans portfolio totals P dollars of loans (D_p) and an estimated default probability of q_p . A subset of borrowers with loans totaling S dollars supply information which allows them to be grouped into *Pool A* with outstanding principal of D_s , leaving D_{p-s} as *Pool B*. The initial pool of D_p with a probability of default of q_p is divided thus into two pools for which the lender has different expectations of default:

$$q_p D_p = q_{\text{signal}} D_s + q_{\text{nosig}} D_{p-s} \quad (4)$$

From (3) the premium for the S loan dollars in *Pool A* is

$$p_{\text{signal}} = \lambda_{\text{signal}} (1 + r_o) \quad \left[\text{where } \lambda_{\text{signal}} = \frac{q_{\text{signal}}}{1 - q_{\text{signal}}} \right]$$

Likewise the premium for the $P-S$ loan dollars in *Pool B* is

$$p_{\text{nosig}} = \lambda_{\text{nosig}} (1 + r_o) \quad \left[\text{where } \lambda_{\text{nosig}} = \frac{q_{\text{nosig}}}{1 - q_{\text{nosig}}} \right]$$

It follows that

$$\frac{p_{\text{signal}}}{\lambda_{\text{signal}}} = \frac{p_{\text{nosig}}}{\lambda_{\text{nosig}}} = \frac{p_p}{\lambda_p} = 1 + r_o$$

meaning that

$$p_{\text{signal}} = \left[\frac{\lambda_{\text{signal}}}{\lambda_{\text{nosig}}} \right] p_{\text{nosig}} \quad (5)$$

This indicates that premia differences across pools are described by their relative default weightings. Assuming a rational firm will not signal it is a defaulter, then:

$$q_{\text{signal}} < q_p < q_{\text{nosig}}$$

meaning that

$$p_{\text{signal}} < p_p < p_{\text{nosig}} \quad (6)$$

That is, the premium charged to firms signaling their superior loan quality (*Pool A*) is less than the premium charged to the nonsignalling firms (*Pool B*) which is higher than the original premium due to the increased default probability for the remaining nonsignalling pool. As more firms successfully signal their superior quality, the default probability for the nonsignalling residual pool will approach a level of unacceptable risk to the lender, at which stage the remaining firms may be screened out of the lending portfolio.¹² On this basis, loan applicants that do not signal their quality may be rationed out of the loan market, depending on the degree of homogeneity among lenders. This accords with the suggestion of Stiglitz and Weiss¹³ that interest rates can act as a screening device. Stiglitz and Weiss propose that banks will not always increase the interest rate they charge, even in the face of excess demand for funds, as this might lead to an unacceptably high default risk. They reason that higher interest rates reduce the proportion of low risk borrowers, and may induce borrowers to take riskier actions. Perhaps more saliently, it accords with the proposition of Keasey and Watson that:

... it is probably inevitable that some element of 'credit rationing' will arise simply as a consequence of ... costly to remedy asymmetric information.¹⁴

Homogeneity of borrowers is further diminished if other premia are applicable, as described below.

Multiple Information Adjustments

A lender may use information sourced independently of the borrower, such as historical default rates for firms at particular stages of development or in particular industry categories. The lender then applies different premia (establishing more pools) for groups of firms to compensate for categorical risks and lending costs such as may relate to loan size and organizational form.¹⁵ The premium component of

the interest rate r_i charged for loan i can then be described as the sum of the various premia charged for all categorical factors relevant to the particular loan and the information supplied by the borrower:

$$r_i - r_o = \sum_{j=1}^J p_{ij} \quad (7)$$

This aggregation of premia inhibits the simple comparison obtained at (5). As the number of factors increases, the interest rates charged by a lender appear more loan-specific. The pooling effect is more observable if there are relatively few factors.

Discussion

Signals are actions or choices by owner-managers that may be interpreted as indicators of the relative quality of their firms. The following discussion of what might reasonably function as categorical signals is based largely on empirical studies of small firm risk measures, debt rationing, and lender behavior.

The literature dealing with the possible information value of financial statements suggests that they might be considered key signaling devices. Prior research also directs attention to the stage of development or age and industry as associated with information levels and financial risk, while collateral is traditionally identified in the context of signaling and debt. The role of human assets is more ambiguous. These potential signals or information cues are considered briefly in the remainder of this section.

Financial Statements

The relevance of financial statements to lenders' assessments of default risk is directly addressed in the financial distress modeling literature which has used components of financial statements to construct models for small unlisted companies.¹⁶ The professional literature also directs bankers' attention to the need to analyze financial statements in lending decisions, arguing that this would enable anticipation of financial difficulties. Stanga and Tiller report that U.S. bank loan officers place considerable importance on financial statements when evaluating loan applications from small businesses.¹⁷ Beaulieu reports that the credibility of financial information presented by borrowers enter loan officers' judgements interactively with accounting information.¹⁸

Industry

Firms in similar industries are expected to have broadly similar business risk and volatility of earnings.¹⁹ A lender's knowledge of default rates for particular industries and industry outlooks will be used in evaluating individual loans.

Lenders also may incur different costs in evaluating and monitoring loans to different industries, reflecting idiosyncratic information sets and the technical and economic complexity of particular industries. Industry may also affect the impact of information cues or other risk proxies. In particular, industry may influence human capital levels, the nature and availability of collateral, and loan size.

Stage of Development and Age Effects

A lender's access to information on a borrower's ability may increase the longer the firm has been in business and with the length of the bank-client relationship. Although a longer bank-client relationship indicates a greater opportunity for the bank to acquire information about a business and its owner-managers, the extent to which this proxy for information access explains variation in interest rate premia may be subsumed in the age of the business. Several studies all indicate that variability in firm performance and the probability of failure decrease with firm age.²⁰ Firm age also may proxy for acquisition of human capital (see below) or an owner's ability and propriety, or indicate past profitability. Jovanovic and Lippman and Rumelt argue that firms' efficiencies are learned over time, inducing an age effect.²¹

Collateral

Bester argues that investors with low default probabilities will reveal themselves by accepting collateral requirements that would be unattractive to high-risk applicants.²² This should induce an inverse association between collateral requirements and interest rate differentials. If owner-managers are largely passive contract takers, collateral requirements and interest rate differentials may be codetermined—both might reflect default risk. This suggestion of codetermination is yet to be addressed empirically but may have important implications for the role of collateral in small firm borrowing.

Distinguishing access to debt and the pricing issue, access to loans under information asymmetry may be significantly influenced by the availability of sufficient collateral. This is consistent with Bester, as well as the competing Stiglitz and Weiss and de Meza and Webb views, that information asymmetry can lead to an undersupply and oversupply of finance respectively.²³ There is substantial evidence that full collateralization of loans is common for owner-managed firms.²⁴ How the price of debt is affected by the *source* of collateral remains unaddressed, both analytically and empirically.

Human Capital

The potential role of human capital is rendered ambiguous by the asset specificity problem that it may engender. This is

briefly considered in Pua and Shailer where it is argued that a high degree of specificity in the human capital held by a firm may raise the cost of capital.²⁵ This can be exacerbated where the human capital pertains to the owner-manager as this diminishes the salability of the business as a going concern. Such an effect should be less likely where secured collateral is primarily nonproductive, as in the case of domestic assets.

That the human capital of the owner-manager is positively related to the survival prospects of a firm is argued in Cressy.²⁶ He argues that an individual's human capital stock is (initially) increasing with age, thus indicating learning. Cressy argues that longer surviving businesses should attract lower interest rate margins due to increased human capital and security (through asset growth).²⁷ Cressy tests this notion using the number, age, experience, and education of owner-managers as measures of human capital. He reports that firms self-select for bank financing on the basis of the owner-managers' human capital and that assets play little or no role in the lending process. This appears to conflict with the role of collateral identified in previous studies but is consistent with findings regarding the association between access to finance and ages of individuals or their businesses.

Conclusions

The model developed here is highly stylized but nonetheless appears consistent with observed features of lending practice—both in terms of the likely use of information cues and the step-nature of interest rate schedules. The expected usefulness of the model presented here is twofold. First, it may prompt potential borrowers to consider more explicitly what they expect to be the payoff from providing particular information items to lenders or adopting particular strategies to show their creditworthiness. This may avoid incurring the costs of less relevant data provision or actions (including increasing the information burden for lenders) or to identify potentially more effective signaling strategies when negotiating financing arrangements.

Second, and perhaps of more immediate value, it provides another potential tool in studying the access to and costs of financing for small firms and entrepreneurs, potential differences in behavior or decision bases across lenders, and cost-benefit analyses of signaling devices. Empirical application of the categorical pricing model by researchers may, in turn, provide borrowers with more specific data on the (historically) obtained benefits of different signals which they can use as input to their determination of signaling strategies.

As something of a caveat, the final impact of signals or information cues on interest rates are intended to reflect the

extent to which they describe a firm's prospects and the recoverability of debt. The role of secured collateral may be paramount in this respect as the availability of such an option to a lender in the advent of default may ameliorate the effects of other signals or cues because the threat of loss to the lender is accordingly diminished. At this stage,

however, this remains an empirical issue. Sufficiently fine measurements may still allow detection of premia effects of other signals even in the presence of high-quality security. Access to appropriate data for loan applications and lenders' decisions may be the main barrier to empirically testing the propositions implicit in the model.

Endnotes

1. G. A. Akerlof, "The Market for 'Lemons': Quality and the Market Mechanism," *Quarterly Journal of Economics* 84, no.3 (August 1970), pp. 488–450.
2. See for example, H. Leland and D. Pyle, "Information Asymmetries, Financial Structure and Financial Intermediation," *Journal of Finance* 32 (May 1977), pp.371–387; S. A. Ross, "The Determination of Financial Structure: The Incentive-signaling Approach," *Bell Journal of Economics* 8 (Spring 1977), pp.23–40; and T. S. Campbell and W. A. Kracaw, "Information Production, Market Signaling, and the Theory of Financial Intermediation," *Journal of Finance* 35 (1980), pp. 836–882; 2. D. Diamond, "Financial Intermediation and Delegated Monitoring," *Review of Economic Studies* 51 (1984), pp.393–414.
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5. Akerlof, "The Market for 'Lemons': Quality and the Market Mechanism."
6. D. M. Jaffee and F. Modigliani, "A Theory and Test of Credit Rationing," *American Economic Review* 59 (1969), pp.850–871.
7. Ibid, p. 860.
8. This aspect of the model was initially developed in G. E. P. Shailer and F. T. Nartey, "Lemons Pricing as an Incentive for Signaling by Small Firms." Unpublished working paper, Department of Commerce, The Australian National University, Canberra, 1994.
9. This assumes that borrowers have more information on their prospects than lenders. If a firm reveals that its probability of default *exceeds* that assigned to its prospective loan pool, it will be rejected by the lender as a defaulter or placed in a pool with a higher default probability and consequently a higher default premium.
10. This assumes there is no change to the lender's beliefs concerning the default rate for the *total* loans portfolio.
11. While this stepwise determination of interest rates appears simplistic, a continuous differential ranking of loans does not accord with the observed interest rates charged to small firms. The stepped nature of quoted rates suggests groups of borrowers are priced (ranked) equally by the lender, implying equivalent multiple loan pools.
12. As an increasing proportion of loans are identified as good, the increased premium to remaining firms provides an increasing incentive to signal their quality. If the costs of signaling are sufficiently low, then eventually only defaulters should be left in the pool. However, signaling costs and uncertainty suggest there will always be a positive default risk for any pool of loans.
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15. This suggests that not all nonsignalling borrowers will be rationed out of the bank's portfolio if the other available information is sufficient to reduce the premium below the bank's screening value.
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Dr. Greg Shailer is a member of the Department of Commerce at the Australian National University. His research interests include the decision making, performance, evaluation and economic behavior of owner-managed firms. He received his Ph.D. from the University of Adelaide.